

# C20 MINIATURE CO<sub>2</sub> SENSOR

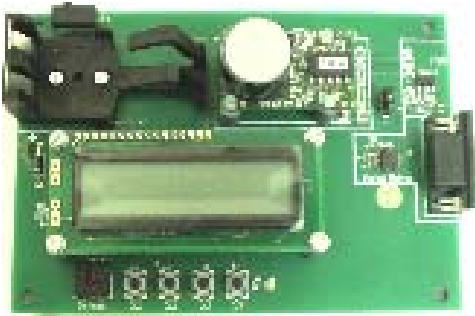
## GETTING STARTED

The C20 can be run using just four connections - +5V, 0V, Serial In and Serial Out. Once powered up, it will immediately start to transmit CO<sub>2</sub> readings twice per second. This can be read directly by connecting to a microcontroller or can be connected to a PC using a suitable serial driver chipset.

The sensor outputs actual CO<sub>2</sub> readings, compensated for temperature in the range -25°C to +55°C.



Part no. 2112BC20



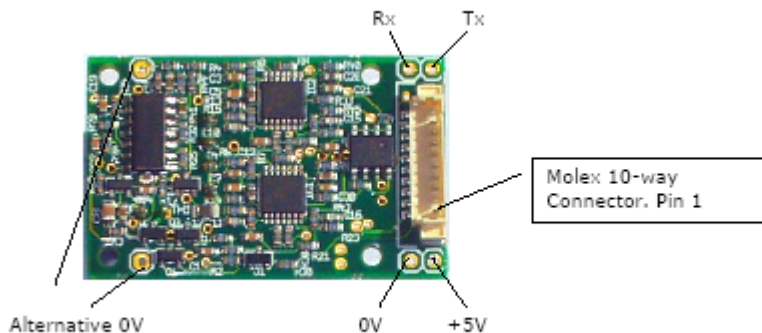
Part no. 2112BC20-KIT

## DEVELOPMENT KIT

For a really quick start, we strongly recommend the C20 Development Kit. This comprises of one C20 CO<sub>2</sub> sensor mounted on a development board with a display, voltage regulator, serial driver and standard 9-pin D type socket for connection directly to a PC and an interface programme to allow some configuration of the C20.

## SENSOR CONNECTIONS

The C20 can be connected using the Molex locking socket or by connection to four plated through holes.



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## MOLEX SOCKET

Connection to the sensor is via a Molex 533981071 locking header plug. The mating part is Molex 51021-1000. At the time of writing, the Farnell order codes for the mating connector and crimped cables are 873-3124 and 112-5276.

The pin connections are:

PIN	USE	COMMENTS
1	+5V	Positive supply 4.7V to 5.5V
2	N/C	Factory calibrated use only
3	ZERO	Pull low to zero the unit
4	N/C	Factory calibrated use only
5	SERIAL TRANSMIT	NB inverted
6	SERIAL RECEIVE	NB inverted
7	N/C	Factory calibrated use only
8	N/C	Factory calibrated use only
9	AIR ZERO	Pull low to zero the unit in ambient air
10	GND	Supply 0V

**! IMPORTANT** – do not exceed the maximum supply voltage of 5.5V. Please ensure that the supply polarity is correct before power up !

## THROUGH HOLE CONNECTIONS

As an alternative to the Molex connector, the C20 can be operated by connecting to the through plated holes located either side of the Molex connector. These can accommodate standard 0.1" pitch pin headers or soldered connections.

## COMMUNICATIONS

### SERIAL PROTOCOL

The format is set as follows:

- 9600 baud
- 8 bit
- no parity
- 1 stop bit

There is no hardware flow control.



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## COMMUNICATIONS

### OUTPUT FORMAT

Each output record consists of a number of field characters followed by their value and terminated with an `\r\n` (carriage return, line feed).

```
Z ##### z ##### \r\n
```

For example:

```
Z 00017 z 00020 \r\n
```

This would indicate a reading of 170ppm on the high resolution output and 200ppm on the fast response output.

Other data fields can be accessed by configuring the unit. These fields include ADC outputs of PCB and gas head temperature sensors and an optical signal strength output (see advanced features).

### ZEROING

The zero for the sensor should be set periodically. It is stored in non-volatile memory, so does not need to be set every time the unit is switched on.

#### Zeroing in Nitrogen (recommended)

- Place the sensor in 100% Nitrogen and allow the output to settle (~1min).
- Pull pin 3 low for at least 1s.
- The sensor will respond by sending "N #####" where ##### is a 5 digit number.

If Nitrogen is not available, it is possible to calibrate in ambient air (preferably 'outside' air).

#### Zeroing in Ambient Air (assumed to be 450ppm)

1. Place the sensor in ambient air and allow the output to settle (~1min).
2. Pull pin 9 low for at least 1s.
3. The sensor will respond by sending "A #####" where ##### is a 5 digit number.



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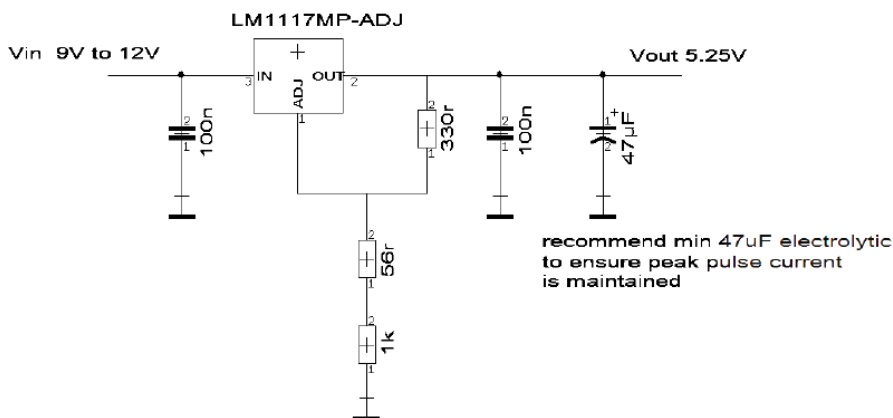
## POWER SUPPLY

**! IMPORTANT** – the power supply needs to have the ability to deliver the 200mA pulses drawn by the NDIR LED Driver. We recommend an LM1117, 3 terminal regulator circuit with 47uF or greater capacitor on its output. The power supply should preferably be at least 3 times over rated, ie. It should be able to deliver 600mA pulses without dipping !

The power supply for the sensor must be correct for the sensor to operate to specification. The absolute limits are 4.7V to 5.5V supply to the sensor.

The peak current is 220mA and the supply must be capable of maintaining the supply voltage within the absolute limits at all times.

The Development Kit uses the following supply circuit:



## ADVANCED FEATURES

### SOFTWARE ZEROING

The C20 sensor can be zeroed remotely by sending a zero command over the serial link. The serial protocol is the same as for receiving data from the sensor.

- If the sensor is being zeroed in Nitrogen, send the Zero command by typing U followed by enter.
- The sensor will respond by sending "U #####" where ##### is a 5 digit number.
- If the sensor is being zeroed in ambient air, send the Zero command by typing G followed by enter.
- The sensor will respond by sending "G #####" where ##### is a 5 digit number.



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## OUTPUT OPTIONS

The serial output from the unit can be altered to give different fields. To alter the output fields, send an 'M' command followed by the total of the mask value for each output required.

FIELD	MASK VALUE	OUTPUT	DESCRIPTION
FAST RESPONSE CO2	2	z #####	In ppm / 10*
FILTERED CO2	4	Z #####	In ppm / 10*
TEMPERATURE**	1	F #####	Temperature in Kelvins x 10

\* Sensor with maximum range > 65% has an output in ppm/100.

\*\* Temperature is not available on all units.

### Example

M 2 ← Fast Output Only z #####  
M 6 ← Fast and Filtered Output Z ##### z #####  
M 5 ← Filtered Output and Temperature Only F ##### Z #####

## FILTER RESPONSE

The filter response can be tuned to optimise for a particular application. This is done by passing a parameter (1 to 128) to the unit using the 'A' command.

### Example

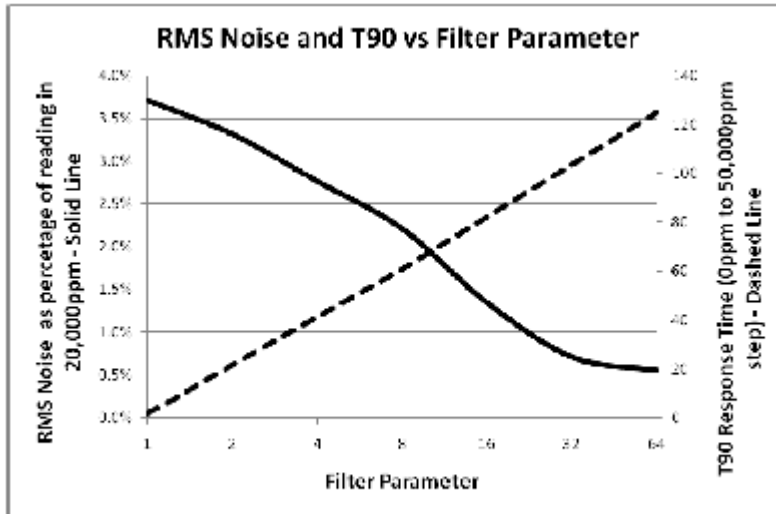
A 32 ←

The filter works broadly as a low pass filter – increasing the parameter reduces the noise but slows the response. The filter parameter must be a power of two – 2,4,8,16, etc. Other values will be interpreted as the next lowest power of two.

The following graph show the trade-off between signal to noise and speed of response for various values of the filter parameter:



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## SMART FILTER

Setting the filter to ) (“A 0 ← “) will switch to the smart filter. This filter adjusts its performance to match the conditions. It will respond quickly to sudden changes but reduce noise in slowly changing signals.

**! IMPORTANT** – the span constant(S) is given from the factory calibration and is not expected to vary with age. Any attempts to alter these parameters may degrade the sensor performance rather than improve it!

## SPAN CALIBRATION

The C20 is fully factory calibrated before shipping. The span value should not require any adjustment and adjustment may reduce the functionality of the sensor.

The C20 span (full scale reading) can be calibrated by using a calibration gas source. The process is as follows:

- 1) Remove any previous span calibration factor by sending “S 8192 ←” to the C20.
- 2) Ensure that the C20 is correctly zeroed using a nitrogen (or zero gas) source.
- 3) Immerse the gas sensor in a gas of known concentration (eg. a calibration gas).
- 4) Allow the gas reading to settle and record the measured gas concentration.



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5) Calculate the calibration factor using the formula

$$CF = (AGC * 8192)/MGC \text{ (round to nearest integer)}$$

Where CF= Calibration Factor

AGC = Actual Gas Concentration

MGC = Measured Gas Concentration

6) Finally, enter the correction factor into the C20 using the command

S ##### ← where ##### is the Correction factor calculated in step 4.

For example, if the calibration gas is 10,000ppm and the reading is 10,200ppm, the value to be entered would be:

$$(10000*8192/10200) = 8031$$

i.e. S 8031 ←

## SPECIFICATIONS

ITEM	VALUE	COMMENTS
DETECTION LIMITS	200ppm	
NOISE AT ZERO	20ppm	Filter setting at 32
WARM UP	120s	For full accuracy
TEMPERATURE RANGE	-25°C – 55°C	
STORAGE TEMPERATURE	-30°C – 70°C	
SUPPLY VOLTAGE	5 Volts	5v +0.5V – 0.3V
SUPPLY CURRENT	20mA	Average. Peak is 220mA
RANGE	Up to 100%	Available as 5%, 20%, 65% and 100%
OUTPUT	TTL Level RS232	9600, n, 8, 1

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